

WEST[Help](#)[Logout](#)[Main Menu](#)[Search Form](#)[Posting Counts](#)[Show S Numbers](#)[Edit S Numbers](#)**Search Results -**

Term	Documents
COVER\$2	0
COVER.USPT.	520431
COVERA.USPT.	4
COVERAE.USPT.	2
COVERAG.USPT.	5
COVERAL.USPT.	5
COVERAM.USPT.	1
COVERAY.USPT.	1
COVERA1.USPT.	1
COVERBY.USPT.	1
(L4 AND (COVER\$2 FACTOR\$2)).USPT.	8

[There are more results than shown above, click here to view the entire set.](#)

Database: [US Patents Full-Text Database](#)

L4 and (cover\$2 factor\$2)

Refine Search:

Search History

<u>DB Name</u>	<u>Query</u>	<u>Hit Count</u>	<u>Set Name</u>
USPT	(cloth\$4) and (Prepreg\$2)	1703	L1
USPT	L1 and woven\$2	932	L2
USPT	L1 and woven\$2	932	L3
USPT	l2 and resin\$2	904	L4
USPT	L4 and (cover\$2 factor\$2)	8	L5

FULL TEXT OF CASES (USPQ2D)

All Other Cases

In re Lee, 61 USPQ2d 1430 (CA FC 2002)

In re Lee, 61 USPQ2d 1430 (CA FC 2002)

61 USPQ2D 1430

In re Lee

U.S. Court of Appeals Federal Circuit

No. 00-1158

Decided January 18, 2002

Headnotes

PATENTS

[1] Practice and procedure in Patent and Trademark Office —Board of Patent Appeals and Interferences — In general (§110.1101)

Patentability/Validity — Obviousness — Combining references (§115.0905)

Patentability/Validity — Obviousness — Evidence of (§115.0906)

Rejection of patent application for obviousness under 35 U.S.C. §103 must be based on evidence comprehended by language of that section, and search for and analysis of prior art includes evidence relevant to finding of whether there is teaching, motivation, or suggestion to select and combine references relied on as evidence of obviousness; factual inquiry whether to combine references must be thorough and searching, based on objective evidence of record, and Board of Patent Appeals and Interferences must explain reasons why one of ordinary skill in art would have been motivated to select references and to combine them to render claimed invention obvious.

[2] Patentability/Validity — Obviousness — Combining references (§115.0905)

JUDICIAL PRACTICE AND PROCEDURE

Procedure — Judicial review — Standard of review —Patents (§410.4607.09)

Board of Patent Appeals and Interferences improperly relied upon “common knowledge and common sense” of person of ordinary skill in art to find invention of patent application obvious over combination of two prior art references, since factual question of motivation to select and combine references is material to patentability, and could not be resolved on subjective belief and unknown authority, since deferential review of agency decisions under Administrative Procedure Act reinforces obligation of board to develop evidentiary basis for its findings, since board's rejection of need for any specific hint or suggestion in particular reference to support combination constituted omission of relevant factor required by precedent, and thus was both legal error and arbitrary agency action, since board's findings must extend to all material facts and be documented on record, and since “common knowledge and common sense” are not specialized knowledge and expertise of agency contemplated by APA, and may not be substituted for evidence, although they may be applied to analysis of evidence.

PATENTS

[3] Practice and procedure in Patent and Trademark Office —Board of Patent Appeals and Interferences — In general (§110.1101)

Patentability/Validity — Obviousness — Evidence of (§115.0906)

JUDICIAL PRACTICE AND PROCEDURE

Procedure — Judicial review — Standard of review —Patents (§410.4607.09)

Patent examiners and Board of Patent Appeals and Interferences, in relying on what they assert to be general knowledge to negate patentability on ground of obviousness, must articulate that knowledge and place it on record, since examiners and board are presumed

Page 1431

to act from viewpoint of person of ordinary skill in art in finding relevant facts, assessing significance of prior art, and making ultimate determination of obviousness issue; failure to do so is not consistent with either effective administrative procedure or effective judicial review, and board cannot rely on conclusory statements when dealing with particular combinations of prior art and specific claims, but must set forth rationale on which it relies.

[4] Procedure — Court of Appeals for the Federal Circuit (§410.03)

Procedure — Judicial review — Standard of review —Patents (§410.4607.09)

U.S. Court of Appeals for the Federal Circuit will not consider proposed alternative grounds for affirming decision of Board of Patent Appeals and Interferences rejecting patent application for obviousness, since alternative grounds were made at oral argument and constitute post hoc rationalization for agency action, consideration of which would deprive aggrieved party of fair opportunity to support its position.

Case History and Disposition

Appeal from the U.S. Patent and Trademark Office, Board of Patent Appeals and Interferences.

Patent application of Sang-Su Lee, serial no. 07/631,210, directed to method of automatically displaying functions of video display device and demonstrating how to select and adjust functions to facilitate user response. Applicant appeals from decision upholding rejection of all claims for obviousness, and from reaffirmation of that decision on reconsideration. Reversed and remanded.

Attorneys:

Richard H. Stern and Robert E. Bushnell, Washington, D.C., for Sang Su Lee.

Sidney O. Johnson Jr., associate solicitor, John M. Whealan, solicitor, and Raymond T. Chen, Maximilian R. Peterson, and Mark Nagumo, associate solicitors, Arlington, Va., for Director of U.S. Patent and Trademark Office.

Judge:

Before Newman, Clevenger, and Dyk, circuit judges.

Opinion Text

Opinion By:

Newman, J.

Sang-Su Lee appeals the decision of the Board of Patent Appeals and Interferences of the United States Patent and Trademark Office, rejecting all of the claims of Lee's patent application Serial No. 07/631,210 entitled "Self-Diagnosis and Sequential-Display Method of Every Function." 1 We vacate the Board's decision for failure to meet the adjudicative standards for review under the Administrative Procedure Act, and remand for further proceedings.

The Prosecution Record

Mr. Lee's patent application is directed to a method of automatically displaying the functions of a video display device and demonstrating how to select and adjust the functions in order to facilitate response by the user. The display and demonstration are achieved using computer-managed electronics, including pulse-width modulation and auto-fine-tuning pulses, in accordance with procedures described in the specification. Claim 10 is representative:

10. A method for automatically displaying functions of a video display device, comprising:
determining if a demonstration mode is selected;
if said demonstration mode is selected, automatically entering a picture adjustment mode having a picture menu screen displaying a list of a plurality of picture functions; and
automatically demonstrating selection and adjustment of individual ones of said plurality of picture functions. The examiner rejected the claims on the ground of obviousness, citing the combination of two references: United States Patent No. 4,626,892 to Nortrup, and the Thunderchopper Helicopter Operations Handbook for a video game. The Nortrup reference describes a television set having a menu display by which the user can adjust various picture and audio functions; however, the Nortrup display does not include a demonstration of how to adjust the functions. The Thunderchopper Handbook describes the Thunderchopper game's video display as having a "demonstration mode" showing how to play the game; however, the Thunderchopper Handbook makes no mention of the adjustment of picture or audio functions. The examiner held that it

Page 1432

would have been obvious to a person of ordinary skill to combine the teachings of these references to produce the Lee system.

Lee appealed to the Board, arguing that the Thunderchopper Handbook simply explained how to play the Thunderchopper game, and that the prior art provided no teaching or motivation or suggestion to combine this reference with Nortrup, or that such combination would produce the Lee invention. The Board held that it was not necessary to present a source of a teaching, suggestion, or motivation to combine these references or their teachings. The Board stated:

The conclusion of obviousness may be made from common knowledge and common sense of a person of ordinary skill in the art without any specific hint or suggestion in a particular reference. Board op. at 7. The Board did not explain the “common knowledge and common sense” on which it relied for its conclusion that “the combined teachings of Nortrup and Thunderchopper would have suggested the claimed invention to those of ordinary skill in the art.”

Lee filed a request for reconsideration, to which the Board responded after five years. The Board reaffirmed its decision, stating that the Thunderchopper Handbook was “analogous art” because it was “from the same field of endeavor” as the Lee invention, and that the field of video games was “reasonably pertinent” to the problem of adjusting display functions because the Thunderchopper Handbook showed video demonstrations of the “features” of the game. On the matter of motivation to combine the Nortrup and Thunderchopper references, the Board stated that “we maintain the position that we stated in our prior decision” and that the Examiner's Answer provided “a well reasoned discussion of why there is sufficient motivation to combine the references.” The Board did not state the examiner's reasoning, and review of the Examiner's Answer reveals that the examiner merely stated that both the Nortrup function menu and the Thunderchopper demonstration mode are program features and that the Thunderchopper mode “is user-friendly” and it functions as a tutorial, and that it would have been obvious to combine them.

Lee had pressed the examiner during prosecution for some teaching, suggestion, or motivation in the prior art to select and combine the references that were relied on to show obviousness. The Examiner's Answer before the Board, plus a Supplemental Answer, stated that the combination of Thunderchopper with Nortrup “would have been obvious to one of ordinary skill in the art since the demonstration mode is just a programmable feature which can be used in many different device[s] for providing automatic introduction by adding the proper programming software,” and that “another motivation would be that the automatic demonstration mode is user friendly and it functions as a tutorial.” The Board adopted the examiner's answer, stating “the examiner has provided a well reasoned discussion of these references and how the combination of these references meets the claim limitations.” However, perhaps recognizing that the examiner had provided insufficient justification to support combining the Nortrup and Thunderchopper references, the Board held, as stated *supra*, that a “specific hint or suggestion” of motivation to combine was not required.

This appeal followed.

Judicial Review

Tribunals of the PTO are governed by the Administrative Procedure Act, and their rulings receive the same judicial deference as do tribunals of other administrative agencies. *Dickinson v. Zurko*, 527 U.S. 150, 50 USPQ2d 1930 (1999). Thus on appeal we review a PTO Board's findings and conclusions in accordance with the following criteria:

5 U.S.C. §706(2) The reviewing court shall—

(2) hold unlawful and set aside agency actions, findings, and conclusions found to be—

(A) arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law;

* * * *

(E) unsupported by substantial evidence in a case subject to sections 556 and 557 of this title or otherwise reviewed on the record of an agency hearing provided by statute;

For judicial review to be meaningfully achieved within these strictures, the agency tribunal must present a full and reasoned explanation of its decision. The agency tribunal

Page 1433

must set forth its findings and the grounds thereof, as supported by the agency record, and explain its application of the law to the found facts. The Court has often explained:

The Administrative Procedure Act, which governs the proceedings of administrative agencies and related judicial review, establishes a scheme of "reasoned decisionmaking." Not only must an agency's decreed result be within the scope of its lawful authority, but the process by which it reaches that result must be logical and rational. *Allentown Mack Sales and Service, Inc. v. National Labor Relations Bd.*, 522 U.S. 359, 374 (1998) (citation omitted). This standard requires that the agency not only have reached a sound decision, but have articulated the reasons for that decision. The reviewing court is thus enabled to perform meaningful review within the strictures of the APA, for the court will have a basis on which to determine "whether the decision was based on the relevant factors and whether there has been a clear error of judgment." *Citizens to Preserve Overton Park v. Volpe*, 401 U.S. 402, 416 (1971). Judicial review of a Board decision denying an application for patent is thus founded on the obligation of the agency to make the necessary findings and to provide an administrative record showing the evidence on which the findings are based, accompanied by the agency's reasoning in reaching its conclusions. See *In re Zurko*, 258 F.3d 1379, 1386, 59 USPQ2d 1693, 1697(Fed. Cir. 2001) (review is on the administrative record); *In re Gartside*, 203 F.3d 1305, 1314, 53 USPQ2d 1769, 1774(Fed. Cir. 2000) (Board decision "must be justified within the four corners of the record").

[1] As applied to the determination of patentability *vel non* when the issue is obviousness, "it is fundamental that rejections under 35 U.S.C. § 103 must be based on evidence comprehended by the language of that section." *In re Grasselli*, 713 F.2d 731, 739, 218 USPQ 769, 775(Fed. Cir. 1983). The essential factual evidence on the issue of obviousness is set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966) and extensive ensuing precedent. The patent examination process centers on prior art and the analysis thereof. When patentability turns on the question of obviousness, the search for and analysis of the prior art includes evidence relevant to the finding of whether there is a teaching, motivation, or suggestion to select and combine the references relied on as evidence of obviousness. See, e.g., *McGinley v. Franklin Sports, Inc.*, 262 F.3d 1339, 1351-52, 60 USPQ2d 1001, 1008(Fed. Cir. 2001) ("the central question is whether there is reason to combine [the] references," a question of fact drawing on the *Graham* factors).

"The factual inquiry whether to combine references must be thorough and searching." *Id.* It must be based on objective evidence of record. This precedent has been reinforced in myriad decisions, and cannot be dispensed with. See, e.g., *Brown & Williamson Tobacco Corp. v. Philip Morris Inc.*, 229 F.3d 1120, 1124-25, 56 USPQ2d 1456, 1459 (Fed. Cir. 2000) ("a showing of a suggestion, teaching, or motivation to combine the prior art references is an 'essential component of an obviousness holding'" (quoting *C.R. Bard, Inc. v. M3 Systems, Inc.*, 157 F.3d 1340, 1352, 48 USPQ2d 1225, 1232(Fed. Cir. 1998)); *In re Dembiczak*, 175 F.3d 994, 999, 50 USPQ2d 1614, 1617(Fed. Cir. 1999) ("Our case law makes clear that the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references."); *In re Dance*, 160 F.3d 1339, 1343, 48 USPQ2d 1635, 1637(Fed. Cir. 1998) (there must be some motivation, suggestion, or teaching of the desirability of making the specific combination that was made by the applicant); *In re Fine*, 837 F.2d 1071, 1075, 5 USPQ2d 1596, 1600(Fed. Cir. 1988) ("teachings of references can be combined *only* if there is some suggestion or incentive to do so.") (emphasis in original) (quoting *ACS Hosp. Sys., Inc. v. Montefiore Hosp.*, 732 F.2d 1572, 1577, 221 USPQ 929, 933(Fed. Cir. 1984)).

The need for specificity pervades this authority. *See, e.g., In re Kotzab*, 217 F.3d 1365, 1371, 55 USPQ2d 1313, 1317(Fed. Cir. 2000) (“particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed”); *In re Rouffet*, 149 F.3d 1350, 1359, 47 USPQ2d 1453, 1459(Fed. Cir. 1998) (“even when the level of skill in the art is high, the Board must identify specifically the principle, known to one of ordinary skill, that suggests the claimed combination.

Page 1434

In other words, the Board must explain the reasons one of ordinary skill in the art would have been motivated to select the references and to combine them to render the claimed invention obvious.”); *In re Fritch*, 972 F.2d 1260, 1265, 23 USPQ2d 1780, 1783(Fed. Cir. 1992) (the examiner can satisfy the burden of showing obviousness of the combination “only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references”).

[2] With respect to Lee's application, neither the examiner nor the Board adequately supported the selection and combination of the Nortrup and Thunderchopper references to render obvious that which Lee described. The examiner's conclusory statements that “the demonstration mode is just a programmable feature which can be used in many different device[s] for providing automatic introduction by adding the proper programming software” and that “another motivation would be that the automatic demonstration mode is user friendly and it functions as a tutorial” do not adequately address the issue of motivation to combine. This factual question of motivation is material to patentability, and could not be resolved on subjective belief and unknown authority. It is improper, in determining whether a person of ordinary skill would have been led to this combination of references, simply to “[use] that which the inventor taught against its teacher.” *W.L. Gore v. Garlock, Inc.*, 721 F.2d 1540, 1553, 220 USPQ 303, 312-13 (Fed. Cir. 1983). Thus the Board must not only assure that the requisite findings are made, based on evidence of record, but must also explain the reasoning by which the findings are deemed to support the agency's conclusion.

Deferential judicial review under the Administrative Procedure Act does not relieve the agency of its obligation to develop an evidentiary basis for its findings. To the contrary, the Administrative Procedure Act reinforces this obligation. *See, e.g., Motor Vehicle Manufacturers Ass'n v. State Farm Mutual Automobile Ins. Co.*, 463 U.S. 29, 43 (1983) (“the agency must examine the relevant data and articulate a satisfactory explanation for its action including a ‘rational connection between the facts found and the choice made.’”) (quoting *Burlington Truck Lines v. United States*, 371 U.S. 156, 168 (1962)); *Securities & Exchange Comm'n v. Chenery Corp.*, 318 U.S. 80, 94 (1943) (“The orderly function of the process of review requires that the grounds upon which the administrative agency acted are clearly disclosed and adequately sustained.”).

In its decision on Lee's patent application, the Board rejected the need for “any specific hint or suggestion in a particular reference” to support the combination of the Nortrup and Thunderchopper references. Omission of a relevant factor required by precedent is both legal error and arbitrary agency action. *See Motor Vehicle Manufacturers*, 463 U.S. at 43 (“an agency rule would be arbitrary and capricious if the agency ... entirely failed to consider an important aspect of the problem”); *Mullins v. Department of Energy*, 50 F.3d 990, 992 (Fed. Cir. 1995) (“It is well established that agencies have a duty to provide reviewing courts with a sufficient explanation for their decisions so that those decisions may be judged against the relevant statutory standards, and that failure to provide such an explanation is grounds for striking down the action.”). As discussed in *National Labor Relations Bd. v. Ashkenazy Property Mgt. Corp.*, 817 F.2d 74, 75 (9th Cir. 1987), an agency is “not free to refuse to follow circuit precedent.”

The foundation of the principle of judicial deference to the rulings of agency tribunals is that the tribunal has specialized knowledge and expertise, such that when reasoned findings are made, a reviewing court may confidently defer to the agency's application of its knowledge in its area of expertise. Reasoned findings are critical to the performance of agency functions and judicial reliance on agency competence. *See Baltimore and Ohio R. R. Co. v. Aberdeen & Rockfish R. R. Co.*, 393 U.S. 87, 91-92 (1968) (absent reasoned findings based on substantial evidence effective review would become lost "in the haze of so-called expertise"). The "common knowledge and common sense" on which the Board relied in rejecting Lee's application are not the specialized knowledge and expertise contemplated by the Administrative Procedure Act. Conclusory statements such as those here provided do not fulfill the agency's obligation. This court explained in *Zurko*, 258 F.3d at 1385, 59 USPQ2d at 1697, that "deficiencies of the cited references cannot be remedied by

Page 1435

the Board's general conclusions about what is 'basic knowledge' or 'common sense.'" The Board's findings must extend to all material facts and must be documented on the record, lest the "haze of so-called expertise" acquire insulation from accountability. "Common knowledge and common sense," even if assumed to derive from the agency's expertise, do not substitute for authority when the law requires authority. *See Allentown Mack*, 522 U.S. at 376 ("Because reasoned decisionmaking demands it, and because the systemic consequences of any other approach are unacceptable, the Board must be required to apply in fact the clearly understood legal standards that it enunciates in principle")

The case on which the Board relies for its departure from precedent, *In re Bozek*, 416 F.2d 1385, 163 USPQ 545 (CCPA 1969), indeed mentions "common knowledge and common sense," the CCPA stating that the phrase was used by the Solicitor to support the Board's conclusion of obviousness based on evidence in the prior art. *Bozek* did not hold that common knowledge and common sense are a substitute for evidence, but only that they may be applied to analysis of the evidence. *Bozek* did not hold that objective analysis, proper authority, and reasoned findings can be omitted from Board decisions. Nor does *Bozek*, after thirty-two years of isolation, outweigh the dozens of rulings of the Federal Circuit and the Court of Customs and Patent Appeals that determination of patentability must be based on evidence. This court has remarked, in *Smiths Industries Medical Systems, Inc. v. Vital Signs, Inc.*, 183 F.3d 1347, 1356, 51 USPQ2d 1415, 1421 (Fed. Cir. 1999), that *Bozek's* reference to common knowledge "does not in and of itself make it so" absent evidence of such knowledge.

[3] The determination of patentability on the ground of unobviousness is ultimately one of judgment. In furtherance of the judgmental process, the patent examination procedure serves both to find, and to place on the official record, that which has been considered with respect to patentability. The patent examiner and the Board are deemed to have experience in the field of the invention; however, this experience, insofar as applied to the determination of patentability, must be applied from the viewpoint of "the person having ordinary skill in the art to which said subject matter pertains," the words of section 103. In finding the relevant facts, in assessing the significance of the prior art, and in making the ultimate determination of the issue of obviousness, the examiner and the Board are presumed to act from this viewpoint. Thus when they rely on what they assert to be general knowledge to negate patentability, that knowledge must be articulated and placed on the record. The failure to do so is not consistent with either effective administrative procedure or effective judicial review. The board cannot rely on conclusory statements when dealing with particular combinations of prior art and specific claims, but must set forth the rationale on which it relies.

Alternative Grounds

[4] At oral argument the PTO Solicitor proposed alternative grounds on which this court might affirm the

Board's decision. However, as stated in *Burlington Truck Lines, Inc. v. United States*, 371 U.S. 156, 168 (1962), "courts may not accept appellate counsel's *post hoc* rationalization for agency action." Consideration by the appellate tribunal of new agency justifications deprives the aggrieved party of a fair opportunity to support its position; thus review of an administrative decision must be made on the grounds relied on by the agency. "If those grounds are inadequate or improper, the court is powerless to affirm the administrative action by substituting what it considers to be a more adequate or proper basis." *Securities & Exchange Comm'n v. Chenery Corp.*, 332 U.S. 194, 196 (1947). As reiterated in *Federal Election Comm'n v. Akins*, 524 U.S. 11, 25 (1998), "If a reviewing court agrees that the agency misinterpreted the law, it will set aside the agency's action and remand the case — even though the agency (like a new jury after a mistrial) might later, in the exercise of its lawful discretion, reach the same result for a different reason." Thus we decline to consider alternative grounds that might support the Board's decision.

Further Proceedings

Sound administrative procedure requires that the agency apply the law in accordance with statute and precedent. The agency tribunal must make findings of relevant facts, and present its reasoning in sufficient detail that the court may conduct meaningful review of the agency action. In *Radio-Television News Directors Ass'n v. FCC*, 184 F.3d 872 (D.C.

Page 1436

Cir. 1999) the court discussed the "fine line between agency reasoning that is 'so crippled as to be unlawful' and action that is potentially lawful but insufficiently or inappropriately explained," quoting from *Checkosky v. Securities & Exch. Comm'n*, 23 F.3d 452, 464 (D.C. Cir. 1994); the court explained that "[i]n the former circumstance, the court's practice is to vacate the agency's order, while in the latter the court frequently remands for further explanation (including discussion of the relevant factors and precedents) while withholding judgment on the lawfulness of the agency's proposed action." *Id.* at 888. In this case the Board's analysis of the Lee invention does not comport with either the legal requirements for determination of obviousness or with the requirements of the Administrative Procedure Act that the agency tribunal set forth the findings and explanations needed for "reasoned decisionmaking." Remand for these purposes is required. *See Overton Park*, 401 U.S. at 420-221 (remanding for further proceedings appropriate to the administrative process).

VACATED AND REMANDED

Footnotes

¹ *Ex parte Lee*, No. 1994-1989 (Bd. Pat. App. & Int. Aug. 30, 1994; on reconsid'n Sept. 29, 1999).

- End of Case -

ISSN 1526-8535

Copyright © 2003, *The Bureau of National Affairs, Inc.*

Reproduction or redistribution, in whole or in part, and in any form, without express written permission, is prohibited except as permitted by the BNA Copyright Policy. <http://www.bna.com/corp/index.html#V>

Printed by EAST

UserID: CPratt

Computer: WS11415

Date: 11/05/1999

Time: 09:09

Document Listing

Document	Image pages	Text pages	Error pages
US 5714419 A	0	9	0
Total	0	9	0

28
25

US-PAT-NO: 5714419
DOCUMENT-IDENTIFIER: US 5714419 A

TITLE: Composite material suitable for aircraft interiors
DATE-ISSUED: February 3, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	RULE
47 Choate; Martin T.	Winona	MN	N/A	N/A	N/A

ASSIGNEE INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE
CODE Fiberite, Inc.	Tempe	AZ	N/A	N/A	02

APPL-NO: 8/ 798234
DATE FILED: February 11, 1997

PARENT-CASE:

RELATED APPLICATION(S) This application is a continuation-in-part application of U.S. patent application Ser. No. 08/286,058, filed Aug. 4, 1994 now U.S. Pat. No. 5,607,769.

INT-CL: [6] B32B009/00

US-CL-ISSUED: 442/136,264/257 ,428/408 ,442/179
US-CL-CURRENT: 442/136,264/257 ,428/408 ,442/179
FIELD-OF-SEARCH: 442/59;442/136 ;442/179 ;428/408 ;264/257

REF-CITED:

		U.S. PATENT DOCUMENTS	
PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
3842144	October 1974	Tanaha et al.	525/83
3985704	October 1976	Jones et al.	260/42.32
4379876	April 1983	Cliheman et al.	524/109
4446255	May 1984	Ying et al.	523/205
4446262	May 1984	Ohumura et al.	524/89
4529755	July 1985	Nishihawa et al.	523/436
4719255	January 1988	Yoshizumi et al.	523/436
4904760	February 1990	Gaku et al.	528/422
4916174	April 1990	Yoshizuma et al.	523/436
5122417	June 1992	Murawami et al.	428/408
5128199	July 1992	Iyer et al.	428/408
5149584	September 1992	Baher et al.	428/408
5216077	June 1993	Yoshizuma et al.	525/68
5360861	November 1994	Campbell	524/494

ART-UNIT: 134

PRIMARY-EXAMINER: Bell; James J.

ATTY-AGENT-FIRM: Gray Cary Ware & Freidenrich

ABSTRACT:

A fiber reinforced prepreg is provided comprising a carbon paper substrate and a thermoset resin with flame retardant components, the prepreg being

particularly useful in the fabrication of aircraft interiors. The substrate may contain PAN carbon fibers and an alcohol binder. The resin may comprise between about 50% to 80% of the prepreg.

9 Claims, 0 Drawing figures
Exemplary Claim Number: 1

BRIEF SUMMARY:

BACKGROUND OF THE INVENTION

The present invention relates to a prepreg that may contain a thermoset resin with flame retardant materials and a substrate impregnated with the thermoset resin that may meet certain flammability requirements for aircraft interior applications and to molded articles prepared from such prepreps.

Electrical and office equipment enclosures, such as computer cases, copier cases and telecommunications equipment, have previously been prepared from thermoplastic resins such as polycarbonates, acrylonitrile butadiene styrene (ABS) and polypropylene. These materials have the advantageous properties of toughness, flexibility and the ability to meet UL specifications by including fire retardant additives. However, the thermoplastics have the disadvantages of not being stiff due to their low modulus and an inability to flow into detailed molds due to their inherently high (molecular weight) melt viscosity. The high melt viscosity also results in an inability to be compounded with much more than 10 to 40% chopped fiber reinforcement resulting in less than half of the modulus values obtainable with thermosets even when such compounded thermoplastics are used. Also because of the relatively high melt viscosities and a lower modulus, thicker wall sections and, in some cases, ribs must be designed into molded parts to provide adequate rigidity and help to prevent burn (melt) through during flammability testing. As a practical matter, it is exceedingly difficult to mold wall sections much less than 0.060" thick due to the thermoplastic resins high melt viscosity and subsequent inability to flow into wall cavities this narrow with conventional injection molding equipment. The thermoplastics also exhibit the phenomena of melting when heat is applied. This phenomena has required the flammability test UL 94 5V itself (burn through test) to be modified so that the gas flame source is angled 20 degrees under the specimen to prevent melted material from dripping into the flame.

One way to overcome the disadvantages of melting (distortion) and the need for thick wall designs due to low modulus would be to use a thermoset resin. However, the conventional thermoset resins (i.e., epoxies and phenolics) are not tough enough for these applications resulting in cracking due to their relatively low impact strength.

In the aircraft industry, a tough, lightweight composite material that may be used in the interior side walls and other non-structural components, such as overhead bins, doors, ceiling, and floors, of an aircraft are desirable. These composite materials must meet the Federal Aviation Administration (FAA) aircraft interior flammability requirements. The desired material must be inexpensive, lightweight, and have a smooth surface finish. The composite material should be able to be compression molded into metal molds, sandwiched, and bonded to a honeycomb core.

A conventional composite material used for aircraft interiors included a woven composite material that required additional manufacture time and expense

because the fabric had to be woven. These woven composite materials were not sufficiently strong to handle the stresses encountered in the aircraft interior, including luggage shifting during take-off and landing. In order to apply any paint or other decoration to the surface of these conventional woven materials, the surface of the finished woven material must first be sanded because the surface of the woven material was not sufficiently smooth to permit paint or other decoration to adhere to the surface. These woven materials also could not readily flow into fine molded details, such as ribs or decoratively etched or molded textures, so that additional finishing of the woven material was required to obtain the fine molded details.

There is a need for a composite material which avoid these and other problems of known composites, and it is to this end that the present invention is directed.

SUMMARY OF THE INVENTION

The invention provides a prepreg particularly suitable for use in the fabrication of aircraft interior non-structural components, such as floors, ceiling, overhead bins, and doors. The invention further provides a composite material which is lightweight, tough, and inexpensive. The composite material may also have a smooth surface finish that permits the composite material to be decorated without additional sanding. The composite material may also flow into a mold to form molded articles with fine molded details. The composite material may also satisfy the FAA aircraft interior flammability requirements of a low heat release rate and a low smoke density during combustion.

In accordance with the invention, a composite material is provided, comprising a modified thermoset resin having flame retardant components, a carbon paper substrate impregnated with said modified thermoset resin, wherein said carbon paper may comprise a predetermined percentage by weight of 0.5 inch length and predetermined percentage by weight of 1 inch length polyacrylonitrile carbon fibers bound together by an alcohol binder, such as polyvinyl alcohol. The thermoset resin may be a phenolic novolac resin, and the amount of resin may be equal to between 50% and 80% by weight based on the total weight of the prepreg. The substrate may have metal fibers to increase the electromagnetic shielding of the prepreg.

DETAILED DESCRIPTION:

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

The invention is particularly applicable to a composite material which is suitable for creating molded articles that may be used for non-structural components in the interior of an aircraft. It is in this context that the invention will be described. It will be appreciated, however, that the composite material in accordance with the invention has greater utility.

The invention broadly is a prepreg that may comprise a thermoset resin that may be impregnated on and into a substrate. Each of these components is described separately below. As is known to those skilled in this art, the term "prepreg" refers to a combination of a substrate such as a mat, fabric, nonwoven material or roving, and a resin that may be usually advanced to a B cure stage. In the cure cycle of a thermosetting resin, an A stage refers to the early stage in the reaction of the resin in which the resin is still

soluble and fusible. A B stage is an intermediate stage in the reaction in which the thermosetting resin melt is being heated and still dissolves in certain solvents. In production, the treated substrate is usually precured to this stage to facilitate handling and processing prior to final cure. A C stage is the final stage in curing the thermosetting resin in which the resin becomes infusible and insoluble in common solvents.

Resins

28 Now, a preferred resin composition of the composite material in accordance with the invention will be described. The resin component employed in the prepregs of the present invention may be a thermoset phenol formaldehyde resin--i.e., a formaldehyde condensate with a malamine phenol. These resins are often referred to as "phenolic" resins. The phenolic resins may be of either the novolac or resole type. However, the novolacs are preferred due to the lower amount of free phenol and/or formaldehyde in these resins. Both the novolacs and resoles are phenol formaldehyde resins. The differences between these two types of phenolic resins result primarily from the ratio of phenol to formaldehyde used in the preparation of the resins. The resole resins are typically prepared with a molar excess of formaldehyde to phenol typically in the range of 1:1.5-2 under alkaline conditions. Novolac resins are prepared with a molar excess of phenol to formaldehyde usually about 1.25:1 under acidic conditions (with oxalic or hydrochloric add). In the resole resin, a trace amount of nitrogen is added to the resin slurry usually in the form of ammonia bubbled through the liquid or hexamethylenetetramine powder is mixed in to help promote reaction between the phenol and formaldehyde. The resole type resin is a relatively lower molecular weight (highly monomeric) semisolid or even liquid resin. It tends to be less stable than the more highly polymerized solid novolac resin at ambient temperatures. The phenol formaldehyde resins are well known and are described in the literature, for example in K. J. Saunders, Organic Polymer Chemistry, Chapman and Hall, N.Y. 1985, and A. Knap--L. A. Pilato, Phenolic Resins Chemistry, Applications and Performance, Springer--Verlong, N.Y. 1985.

Substrate

Now, the substrate of the composite material in accordance with the invention will be described. The substrate employed in the present invention may be any discontinuous fiber, including carbon, glass, kevlar or other conventional fiber reinforcements. Preferred results may be achieved with a carbon paper substrate having a weight of approximately 3 ounces per square yard. This material permits the prepreg manufacturer to achieve a higher prepregging throughput, and customers have fewer sheets to cut for a given charge weight. A preferred carbon paper may be prepared from "PAN" fibers, wherein "PAN" refers to fiber or filler made from polyacrylonitrile starting resin. To bind the carbon fibers together, an alcohol binder, such as polyvinyl alcohol (PVA), may be used. The alcohol binder may comprise between about 2% to 10% by weight of the substrate, and a preferred substrate may comprise about 5% by weight of PVA.

Lower weight substrate materials, such as those having weights of 2 and 2.5 ounces per square yard, may also be used. The substrate may contain 0.5 inch length and/or 1.0 inch length PAN carbon fibers. The substrate may contain

between 50% to 100% by weight of the 0.5 inch PAN carbon fibers and 0% to 50% by weight of the 1.0 inch PAN carbon fibers. A preferred substrate may contain

50% by weight of 0.5 inch length and 50% by weight of 1.0 inch length carbon fibers. The length of the fibers may be varied depending upon the molded article being prepared from the prepreg and/or the mechanical properties required in the molded article.

Preparation of Prepreg

Now, a method for preparing the prepreg in accordance with the invention will be described. A resin composition may be prepared by dissolving the thermoset resin in a suitable solvent for the resin. Solvents which may be used include acetone, methyl ethyl ketone, methylene chloride, or any other low

boiling point (less than 60 degrees C.) solvent. To the resulting solution, additives, such as pigments, flame retardants, lubricants, or cure accelerators

(e.g. hexamethylenetetramine) may be added. The prepreg with the novalac phenolic resin may be stored at room temperatures while the resole type phenolic resin carbon prepreps must be refrigerated during storage.

The prepreg may comprise between 20% to 50% by weight of the substrate and between 50% to 80% by weight of the resin, and a preferred prepreg may comprise about 80% by weight of the resin and about 20% by weight of the substrate.

Preferred results may be achieved when a fire retardant material may be added into the resin composition. Suitable fire retardant materials may include halogen/antimony compounds including, for example, tetrabrominated bisphenol A and antimony oxide. A preferred flame retardant may be a phosphate

ester, such as that manufactured by Hoechst Celanese as product numbers AP422 or IFR 23. An example of a resin compound in accordance with the invention will be described below.

One the resin composition is prepared, the substrate may be impregnated with the resin composition by means which are conventional in the art. In general, the substrate may be run through the resin composition. The substrate and the resin composition may then be dried to remove the solvent and partially cure the resin composition to the B stage. The resulting prepreg may be sheeted, stacked or rolled, and then shipped or stored.

Preparation of Molded Articles

Various molded articles may be prepared from the prepreps in accordance with

the invention by means which are well known to those skilled in the art including compression molding and transfer molding. The prepreg may be molded into highly derailed pieces with wall thicknesses as thin as 1 millimeter.

The details of the molding process, such as cure cycle, temperature and pressure, may be varied depending upon the configuration of the molded article being produced. In general, several sheets of the prepreg may be cut and stacked in a mold. The arrangement of the sheets depends upon the article being produced.

For example extra strips or pieces of the prepreg may be included where extra strength is required in the final molded article. The prepreps of the present

invention provide a design advantage in allowing for the preparation of molded articles having thinner wall sections due to the lower melt viscosity of the resins resulting in lighter weight enclosures having increased internal volume.

The molded articles in accordance with the invention may have a smooth, opaque, shiny surface finish because the substrate has a large amount of surface area which means that a large amount of resin composition may be impregnated within the substrate. Therefore, the prepreg in accordance with the invention has a high resin to substrate ratio of 50-80% resin so that a molded article made with the prepreg may have a smooth resin surface instead of a rougher substrate surface. The smooth surface in accordance with the invention requires no sanding of the molded article surface prior to further decoration. Thus, after the molded article is removed from the mold, paint or vacuum molded decorative light color polymer films may be applied to the surface of the molded article, in accordance with the invention. As described above, conventional woven materials require at least a sanding step prior to applying any decoration to the surface of the molded article.

The prepreg in accordance with the invention may be handled in a similar manner as conventional woven composites, but the prepreg in accordance with the invention may flow into a mold and may form molded articles with fine molded details, such as ribs and decoratively etched or textured surfaces of molded articles. As described above, conventional woven materials do not readily flow into the mold.

These molded articles formed with the composite material in accordance with the invention are less expensive than conventional woven carbon prepreg because the weaving step required for the woven prepreg is eliminated because a discontinuous, filamentized substrate is used. As described below in more detail, the molded articles may also have a low specific gravity and meet the FAA aircraft interior flammability requirements of a low heat release rate and a low smoke density during combustion.

A molded article formed with the prepreg in accordance with the invention also has new acoustic and electrical properties that may be beneficial to the aircraft industry. In particular, the prepreg may have electromagnetic interference (EMI) shielding properties as well as acoustic shielding properties. The discontinuous, filamentized substrate may provide some EMI shielding. To further increase the EMI shielding capabilities, stainless steel fibers or nickel coated graphite fibers may be added into the substrate. A prepreg formed with the additional fibers described above may have EMI shielding of greater than 40 dB over a wide frequency range of 100 Hz to 1000 MHz. The discontinuous filamentized substrate without the additional fibers may also provide acoustic shielding because the substrate, which is not woven, dissipates acoustic energy which reduces the acoustic energy that may be transmitted through the molded article.

In order to describe the present invention so that it may be more clearly understood, the following example is set forth. The example is set forth primarily for the purpose of illustration and any specific enumeration of the details or the material proportions contained therein should not be interpreted as a limitation on the concept of this invention.